# Encapsulation

# Objectives

- Class and Object
- How to identify classes
- Hints for class design
- How to declare/use a class
- Member functions
- Common modifiers (a way to hide some members in a class)
- Case study

# Encapsulation

**Aggregation of data and behavior.**

- Class = Data (fields/properties) + Methods
- Data of a class should be hidden from the outside.
- All behaviors should be accessed only via methods.
- A method should have a *boundary condition:* Parameters must be checked (use if statement) in order to assure that data of an object are always valid.
- Constructor: A special method it’s code will execute when an object of this class is initialized.
- Getters/Setters: implementing **getter** and **setter** is one of the ways to enforce encapsulation in the program’s code.

# How to Identity a Class

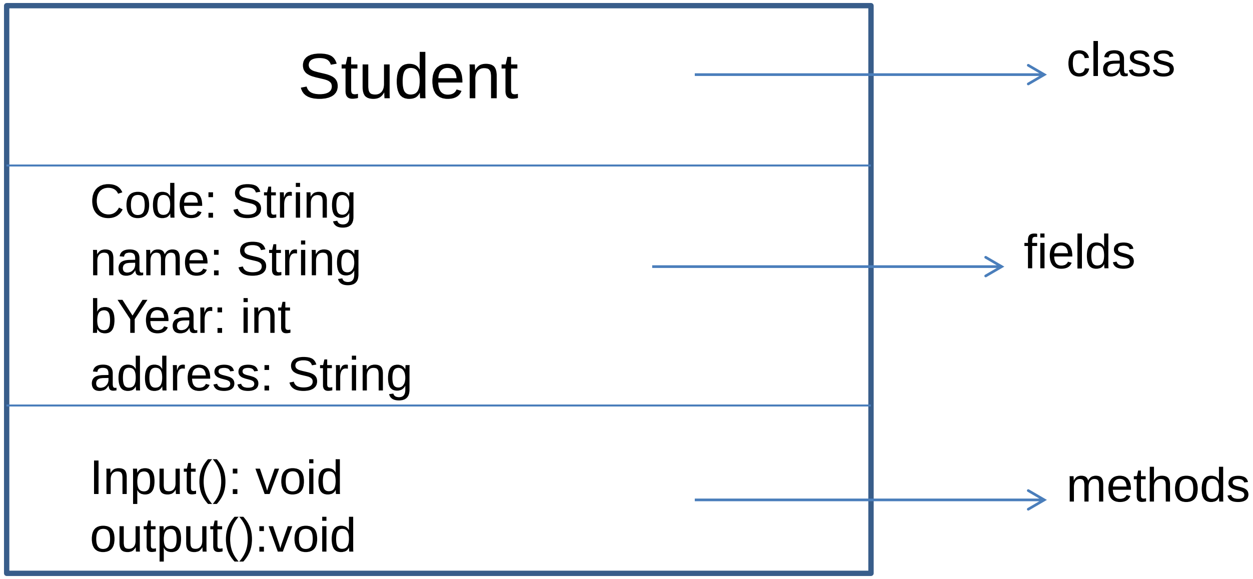
- Main noun: Class
- Nouns as modifiers of main noun: Fields
- Verbs related to main noun: Methods

***For example***, details of a **student** include **code, name, year of birth, address.** Write a Java program that will allow **input** a student, **output** his/her.

**Main noun: Student**
**Auxiliary nouns:code , name, bYear, address;**
**verbs: input() , output()**

# Hints for class design

A UML class diagram is used to represent the Student class



Student

Code: String
name: String
bYear: int
address: String

Input(): void
output():void

class

fields

methods

# Declaring/Using  a Java Class

```
[public] class ClassName [extends FatherClass] {
    [modifier] Type field1 [= value];
    [modifier] Type field2 [= value];
    // constructor
    [modifier] ClassName (Type var1,…) {
        <code>
    }
    [modifier] Type methodName (Type var1,…) {
        <code>
    }
    …….
}
```

Modifiers will be introduced later.

How many constructors should be implemented? → Number of needed ways to initialize an object.

What should we will write in constructor’s body? → They usually are codes for initializing values to descriptive variables

# Member functions: Constructors

- Constructors that are invoked to create objects from the class blueprint.
- Constructor declarations look like method declarations—except that they use the name of the class and have no return type.
- The compiler automatically provides a no-argument, default constructor for any class without constructors.

# Member functions: Constructors

```
//default constructor
public Student(){
   code=“SE123”;
   name=“Hieu”;
   bYear= 2000;
   address=“1 Ba Trieu , HN”.
}
//constructor with parameters
public Student(String code, String name, int  bYear, String address){
   this.code=code;
   this.name=name;
   this.bYear= year;
   this.address=address.
}
```

# The current object: this

- The keyword **this** returns the address of the current object.
- This holds the address of the region of memory that contains all of the data stored in the instance variables of current object.
- **Scope of this: this** is created and used just when the member method is called. After the member method terminates **this** will be discarded

# Member functions: Getter/Setter

- A getter is a method that gets the value of a property.
- A setter is a method that sets the value of a property.
- Uses:
  - ➢for completeness of encapsulation
  - ➢to maintain a consistent interface in case internal details change

# Member functions: Getter/Setter

- For example:

```
public String getName(){
        return name;
}
public void setName(String name){
        if(! name.isEmpty())
                this.name=name;
}
```

# Member functions: other methods

- Typical method declaration:

```
[modifier] ReturnType methodName (params) {
  <code>
}
```

- Signature: data help identifying something
- Method Signature:

  name + order of parameter types

# Member functions: other Methods

- For example:

```
public void input(){
     //code here
}
public void output(){
    //code here
}
```

# Passing Arguments a Constructor/Method

- Java uses the mechanism passing by value. Arguments can be:
  - Primitive Data Type Arguments
  - Reference Data Type Arguments (objects)

# Creating Objects

- Class provides the blueprint for objects; you create an object from a class.

```
Student stu = new
Student(“SE123”,”Minh”,2000,”1 Ba Trieu”);
```

- Statement has three parts:
  - **Declaration**: are all variable declarations that associate a variable name with an object type.
  - **Instantiation**: The new keyword is a Java operator that creates the object (memory is allocated).
  - **Initialization**: The new operator is followed by a call to a constructor, which initializes the new object (values are assigned to fields).

# Type of Constructors
# Create/Use an object of a class

- ***Default constructor***: Constructor with no parameter.
- ***Parametric constructor***: Constructor with at least one parameter.

- **Create an object**

  **ClassName obj1=new ClassName();**

  **ClassName obj2=new ClassName(params);**
- **Accessing a field of the object**

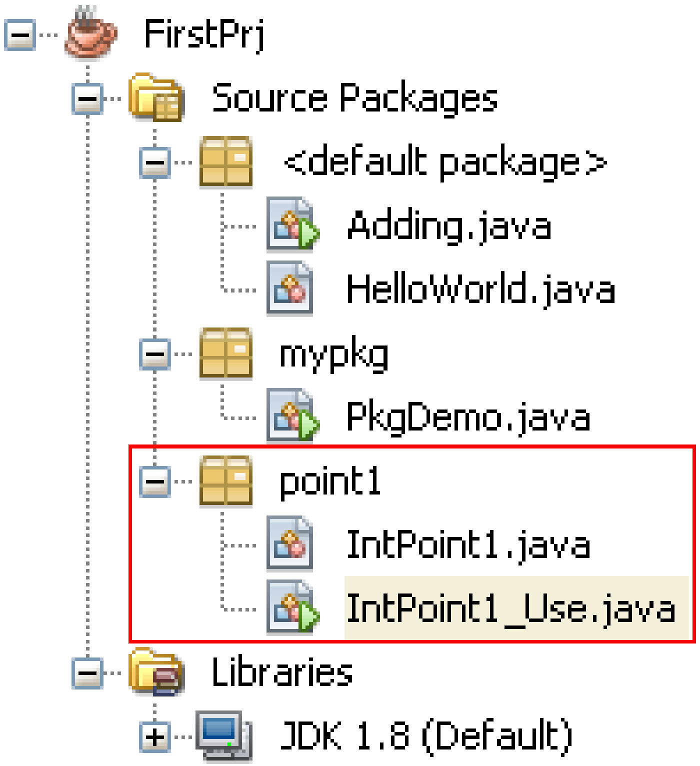
  **object.field**
- **Calling a method of an object**

  **object.method(params)**

# Demo: If we do not implement any constructor, compiler will insert to the class a system default constructor

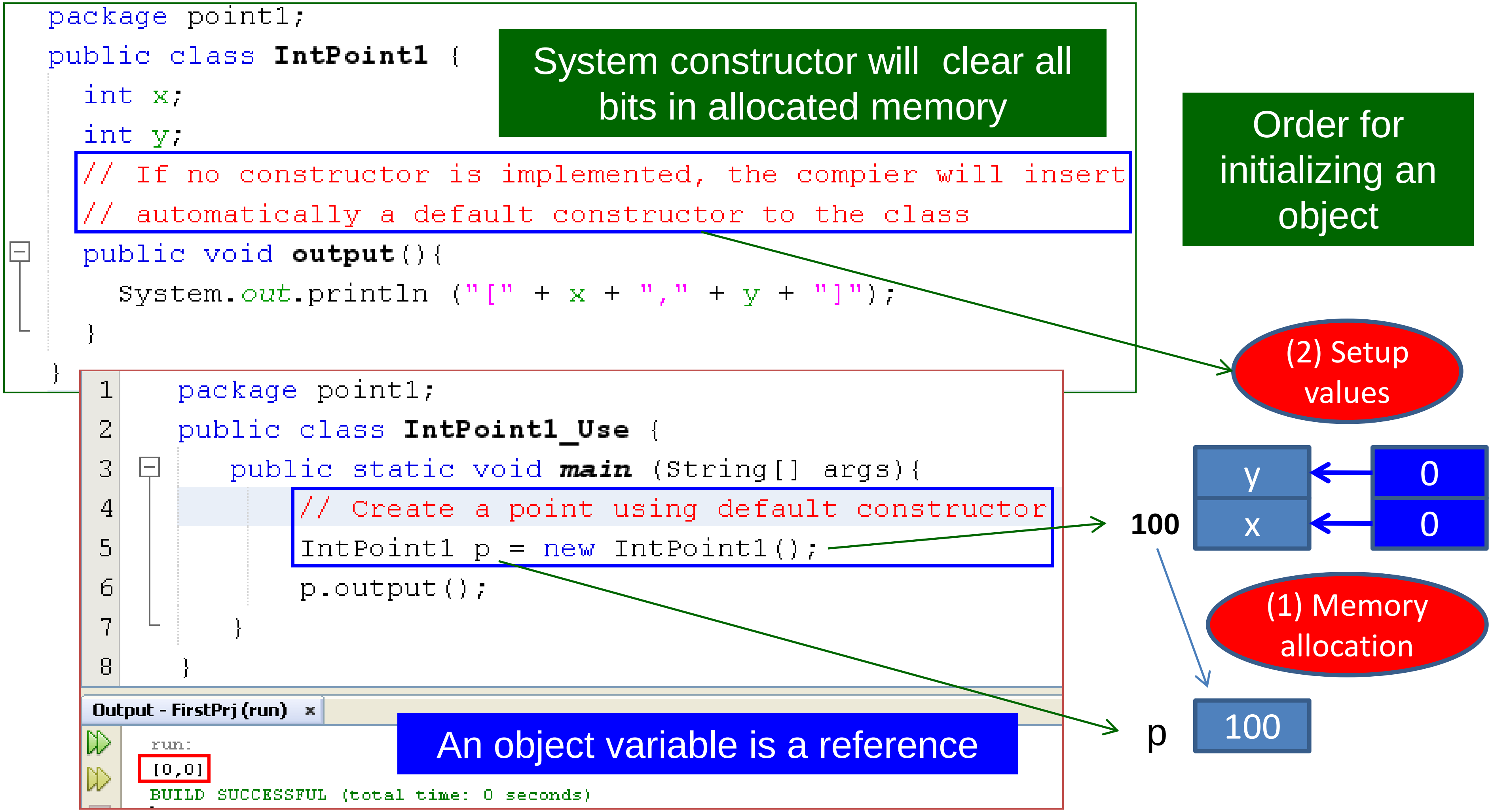
In this demonstration (package **point1)**:

- The class **IntPoint1** represents a point in an integral two dimensional coordinate.
- The class **IntPoint1_Use** having the main method in which the class IntPoint1 is used.



```
FirstPrj
  Source Packages
    <default package>
      Adding.java
      HelloWorld.java
    mypkg
      PkgDemo.java
    point1
      IntPoint1.java
      IntPoint1_Use.java
  Libraries
    JDK 1.8 (Default)
```

# Demo: If we do not implement any constructor, compiler will insert to the class a default constructor



```
package point1;
public class IntPoint1 {
  int x;
  int y;
  // If no constructor is implemented, the compier will insert
  // automatically a default constructor to the class
  public void output(){
    System.out.println ("[" + x + "," + y + "]");
  }
}
```

System constructor will clear all bits in allocated memory

Order for initializing an object

(2) Setup values

(1) Memory allocation

```
package point1;
public class IntPoint1_Use {
   public static void main (String[] args){
       // Create a point using default constructor
       IntPoint1 p = new IntPoint1();
       p.output();
   }
}
```

Output - FirstPrj (run) ×

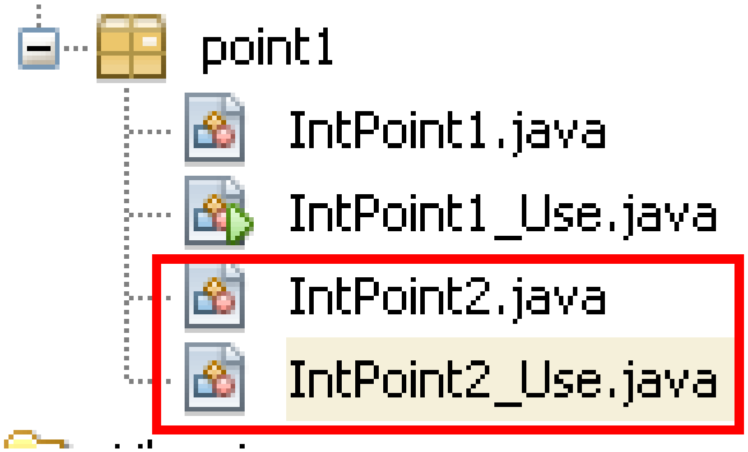
```
run:
[0,0]
BUILD SUCCESSFUL (total time: 0 seconds)
```

An object variable is a reference

# Demo: If we implement a constructor, compiler does not insert default constructor

This demonstration will depict:

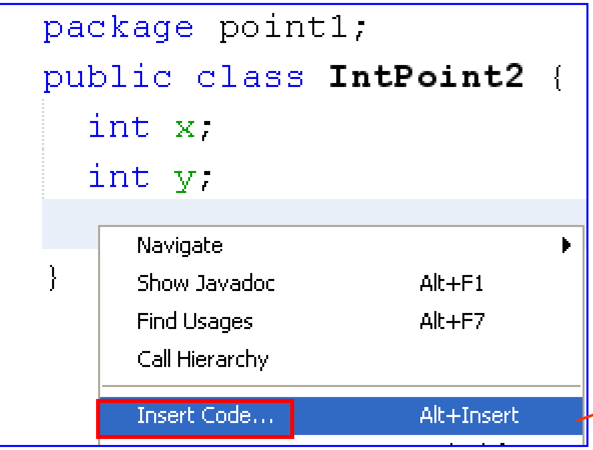
- The way to insert some methods automatically in NetBeans
- If user-defined constructors are implemented, compiler does not insert the system default constructor



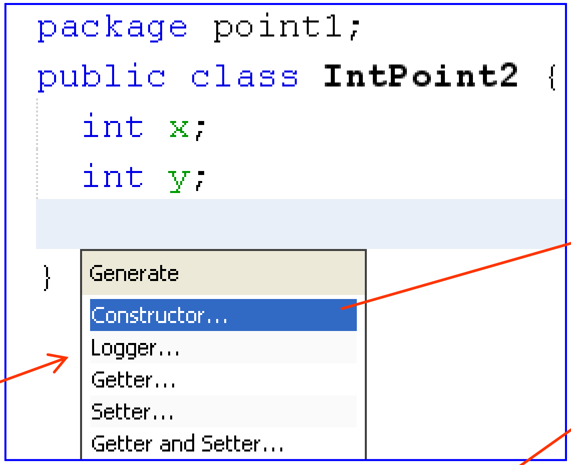
point1<br>
IntPoint1.java<br>
IntPoint1_Use.java<br>
IntPoint2.java<br>
IntPoint2_Use.java

# Demo: If we implement a constructor, compiler does not insert default constructor

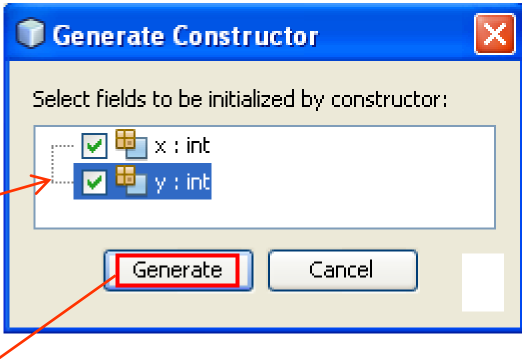
## Insert constructor

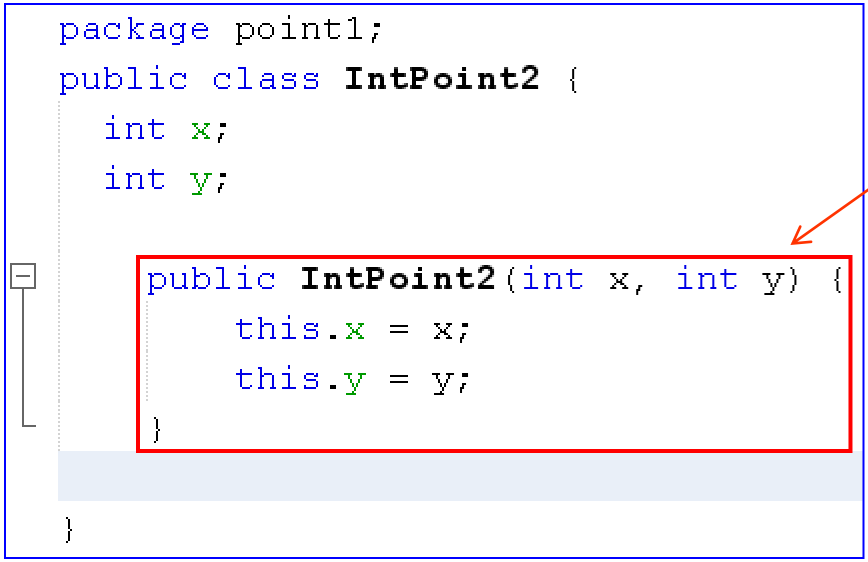


```
package point1;
public class IntPoint2 {
   int x;
   int y;

}
```



```
package point1;
public class IntPoint2 {
   int x;
   int y;

}
```





```
package point1;
public class IntPoint2 {
   int x;
   int y;

   public IntPoint2(int x, int y) {
       this.x = x;
       this.y = y;
   }

}
```

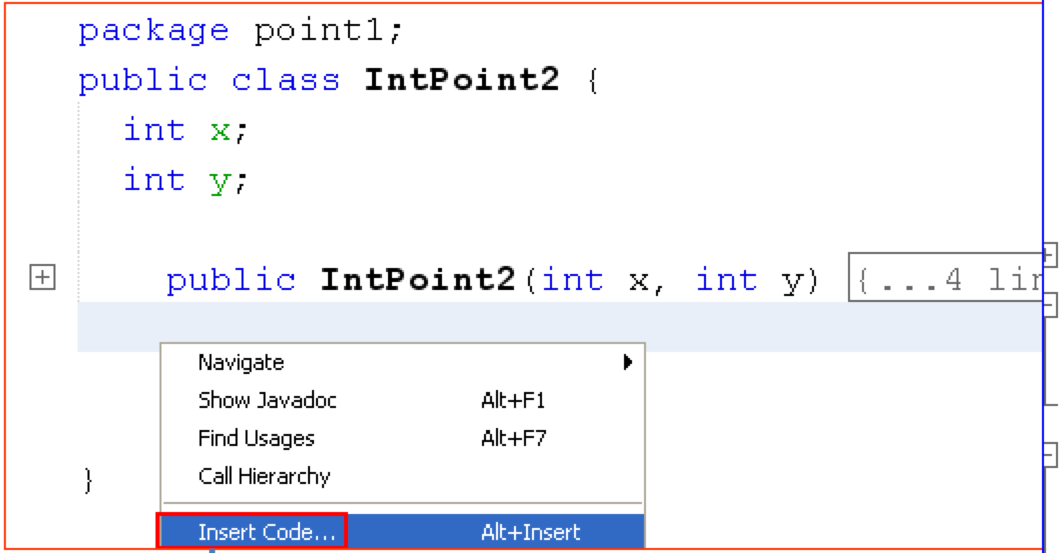
Parameter names are the same as those in declared data filed. So, the keyword **this** will help distinguish field name and parameter name.

**this.x** means that x of this object

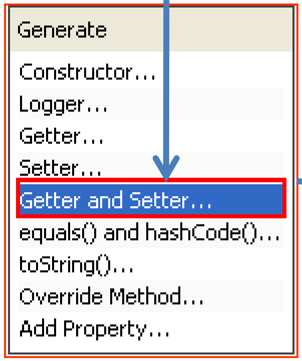
# Demo: If we implement a constructor, compiler does not insert default constructor

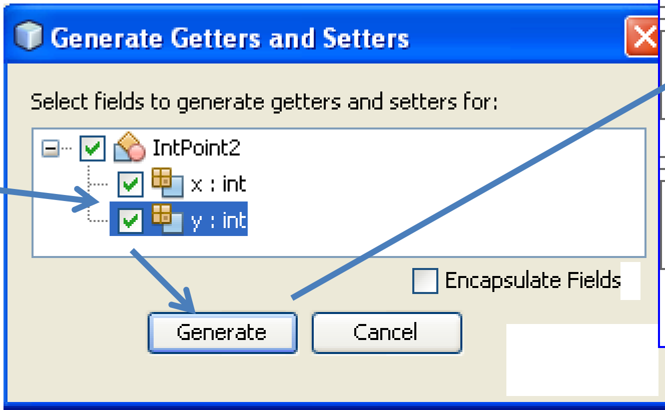
Accessing each data field is usually supported by :
A getter for reading value of this field
A setter for modifying this field

## Insert getter/setter



```
package point1;
public class IntPoint2 {
   int x;
   int y;

   public IntPoint2(int x, int y) {...4 lir
}
```



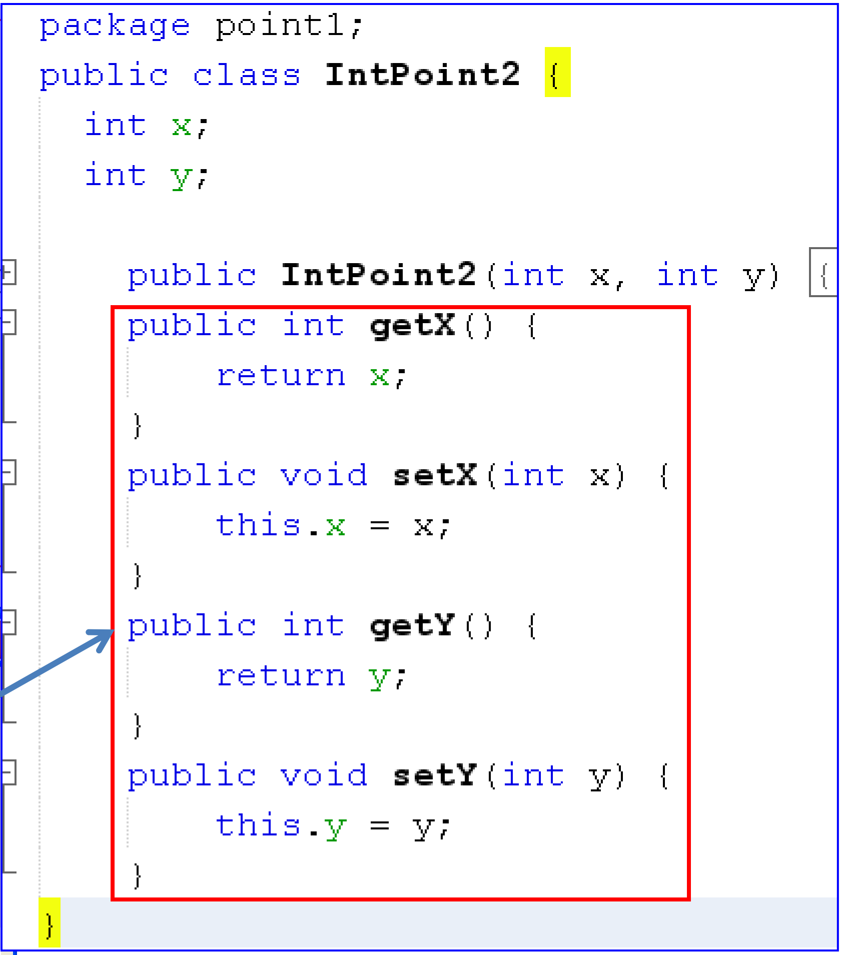


Generate Getters and Setters

Select fields to generate getters and setters for:

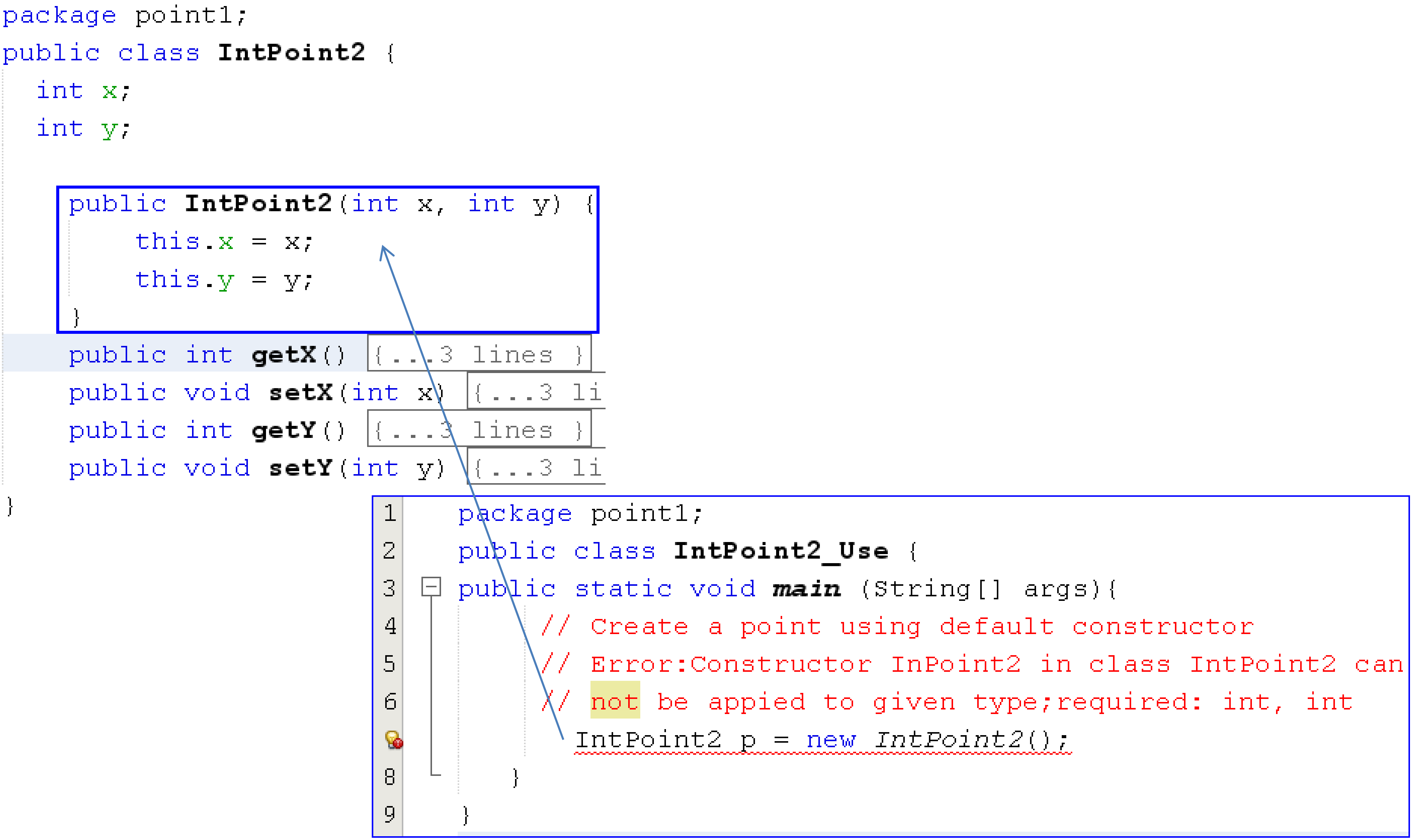
☑ IntPoint2
- ☑ x : int
- ☑ y : int

□ Encapsulate Fields



```
package point1;
public class IntPoint2 {
   int x;
   int y;

     public IntPoint2(int x, int y) {
     public int getX() {
         return x;
     }
     public void setX(int x) {
         this.x = x;
     }
     public int getY() {
         return y;
     }
     public void setY(int y) {
         this.y = y;
     }
}
```

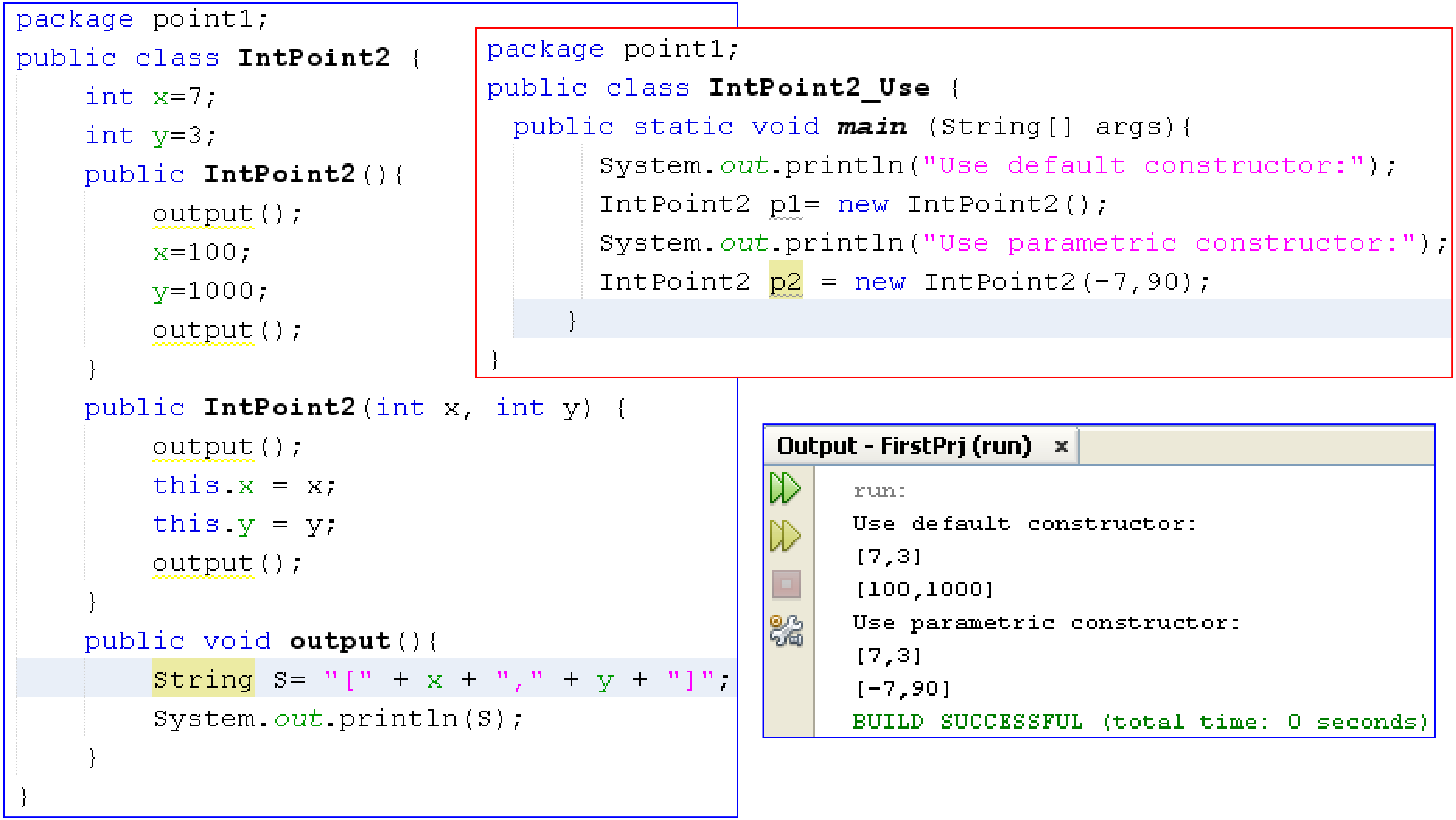
# Demo: If we implement a constructor, compiler does not insert system constructor



```
package point1;
public class IntPoint2 {
  int x;
  int y;

    public IntPoint2(int x, int y) {
        this.x = x;
        this.y = y;
    }
    public int getX() {...3 lines }
    public void setX(int x) {...3 li
    public int getY() {...3 lines }
    public void setY(int y) {...3 li
}
```

```
package point1;
public class IntPoint2_Use {
public static void main (String[] args){
    // Create a point using default constructor
    // Error:Constructor InPoint2 in class IntPoint2 can
    // not be appied to given type;required: int, int
     IntPoint2 p = new IntPoint2();
  }
}
```

# Explain the result of the following program



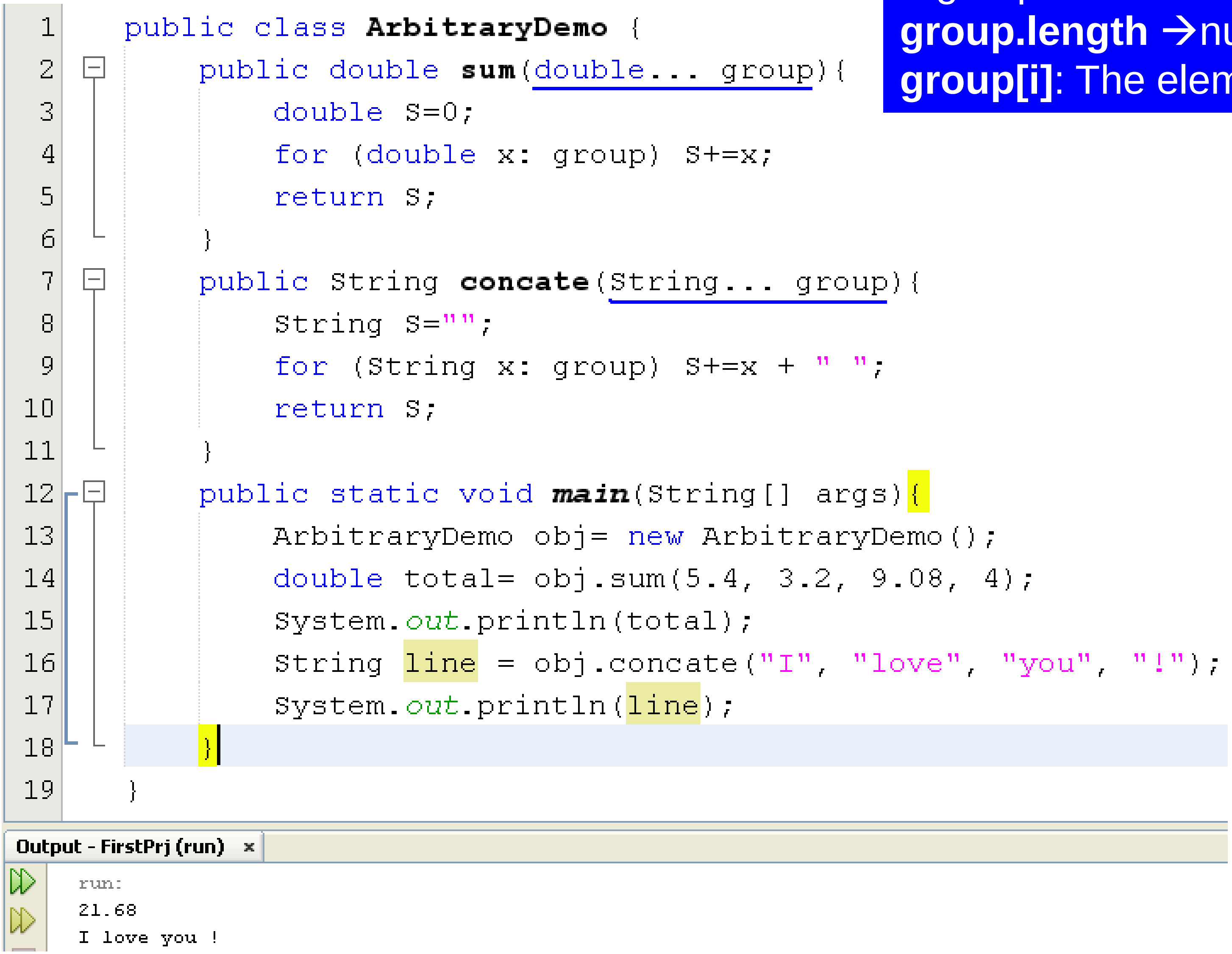
```java
package point1;
public class IntPoint2 {
    int x=7;
    int y=3;
    public IntPoint2(){
        output();
        x=100;
        y=1000;
        output();
    }
    public IntPoint2(int x, int y) {
        output();
        this.x = x;
        this.y = y;
        output();
    }
    public void output(){
        String S= "[" + x + "," + y + "]";
        System.out.println(S);
    }
}
```

```java
package point1;
public class IntPoint2_Use {
  public static void main (String[] args){
        System.out.println("Use default constructor:");
        IntPoint2 p1= new IntPoint2();
        System.out.println("Use parametric constructor:");
        IntPoint2 p2 = new IntPoint2(-7,90);
    }
}
```

```
run:
Use default constructor:
[7,3]
[100,1000]
Use parametric constructor:
[7,3]
[-7,90]
BUILD SUCCESSFUL (total time: 0 seconds)
```

# Demo: Methods with Arbitrary Number of Arguments

A group is treated as an array
**group.length** →number of elements
**group[i]**: The element at the position i



```
public class ArbitraryDemo {
    public double sum(double... group){
        double S=0;
        for (double x: group) S+=x;
        return S;
    }
    public String concate(String... group){
        String S="";
        for (String x: group) S+=x + " ";
        return S;
    }
    public static void main(String[] args){
        ArbitraryDemo obj= new ArbitraryDemo();
        double total= obj.sum(5.4, 3.2, 9.08, 4);
        System.out.println(total);
        String line = obj.concate("I", "love", "you", "!");
        System.out.println(line);
    }
}
```

```
run:
21.68
I love you !
```

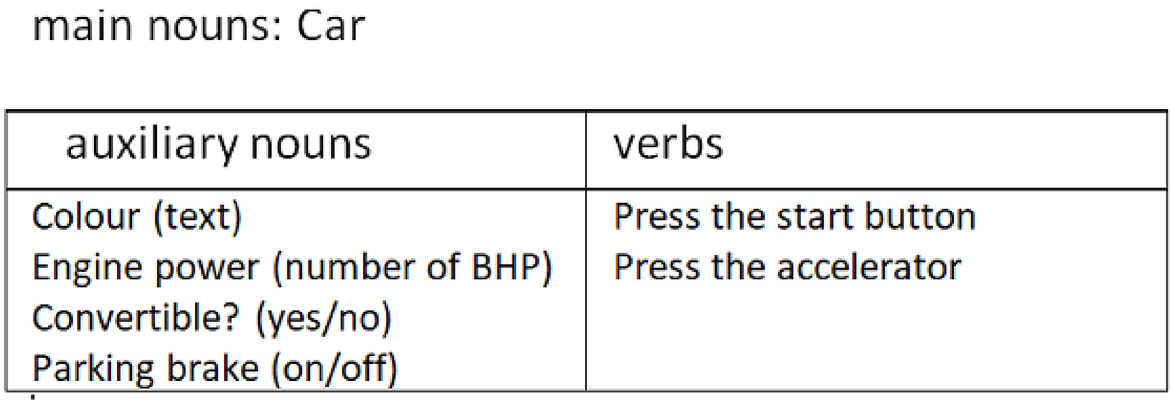
# Case study

- **Problem**:
  A sports car can be one of a variety of colours, with an engine power between 100 HP and 200 HP. It can be a convertible or a regular model. The car has a button that starts the engine and a parking brake. When the parking brake is released and you press the accelerator, it drives in the direction determined by the transmission setting.

# Report…

## Class Design

From the problem description, concepts in the problem domain are expressed by following classes:

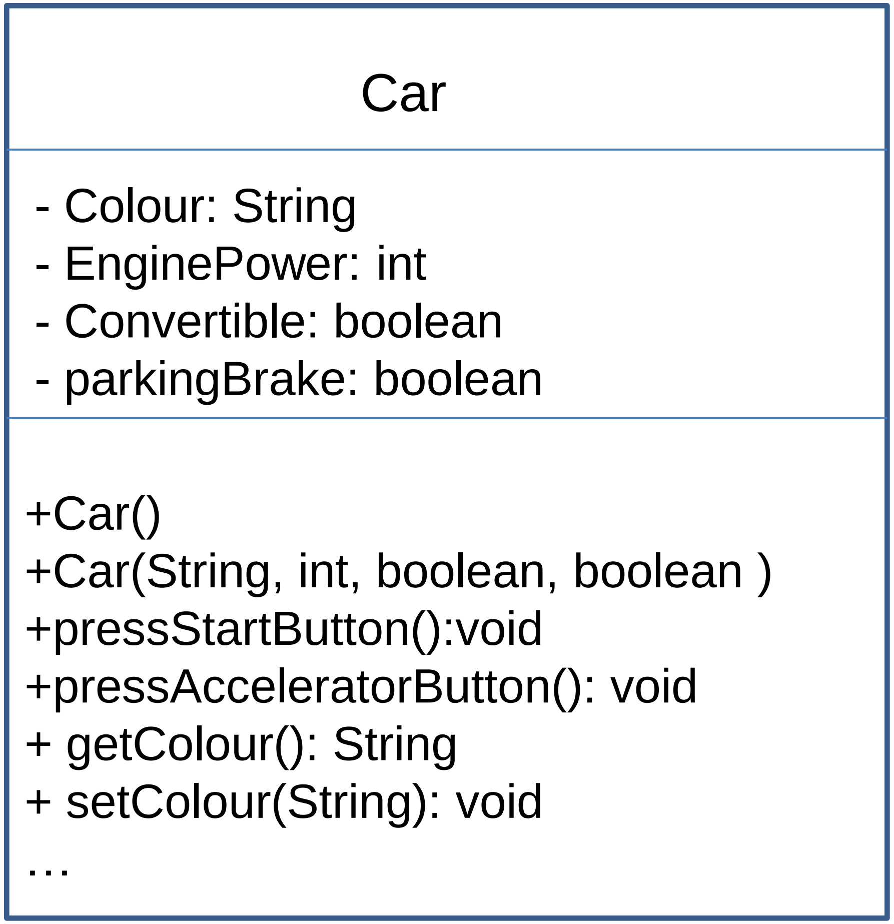


main nouns: Car

| auxiliary nouns | verbs |
|---|---|
| Colour (text)<br>Engine power (number of BHP)<br>Convertible? (yes/no)<br>Parking brake (on/off) | Press the start button<br>Press the accelerator |

# Report…

- A UML class diagram is used to represent the Car class



Car

- Colour: String
- EnginePower: int
- Convertible: boolean
- parkingBrake: boolean

+Car()

+Car(String, int, boolean, boolean )

+pressStartButton():void

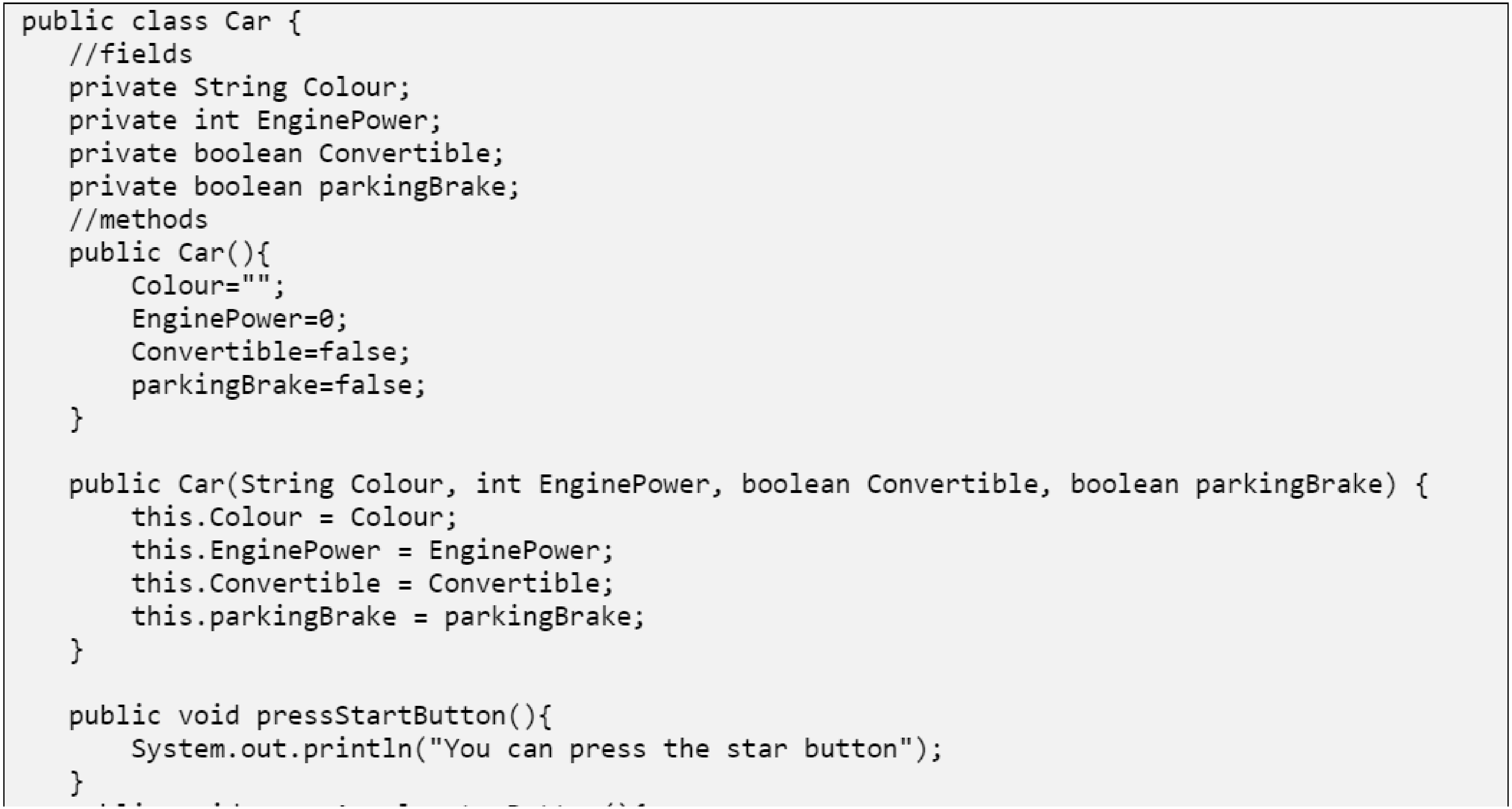
+pressAcceleratorButton(): void

+ getColour(): String

+ setColour(String): void

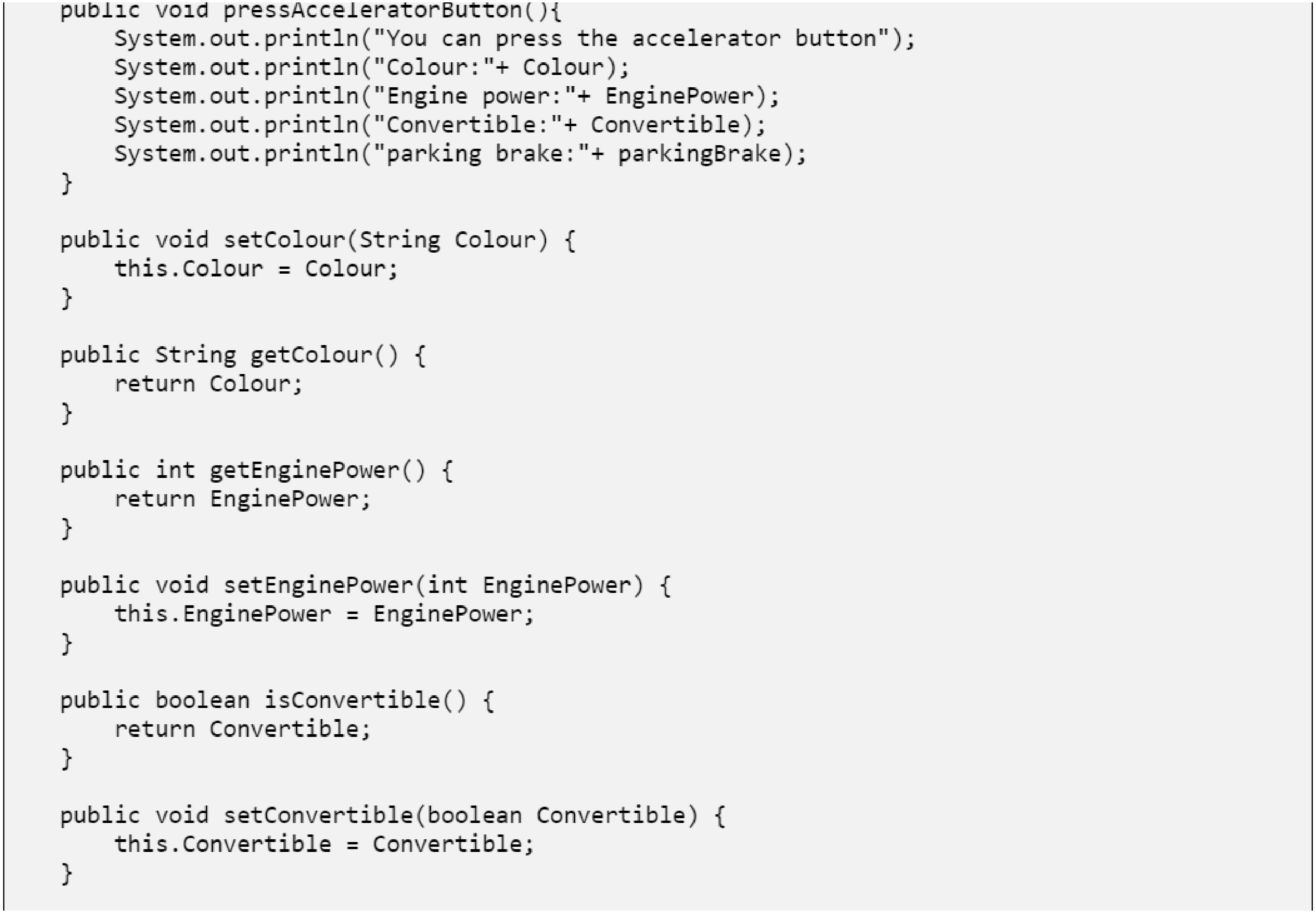
…

# Implement



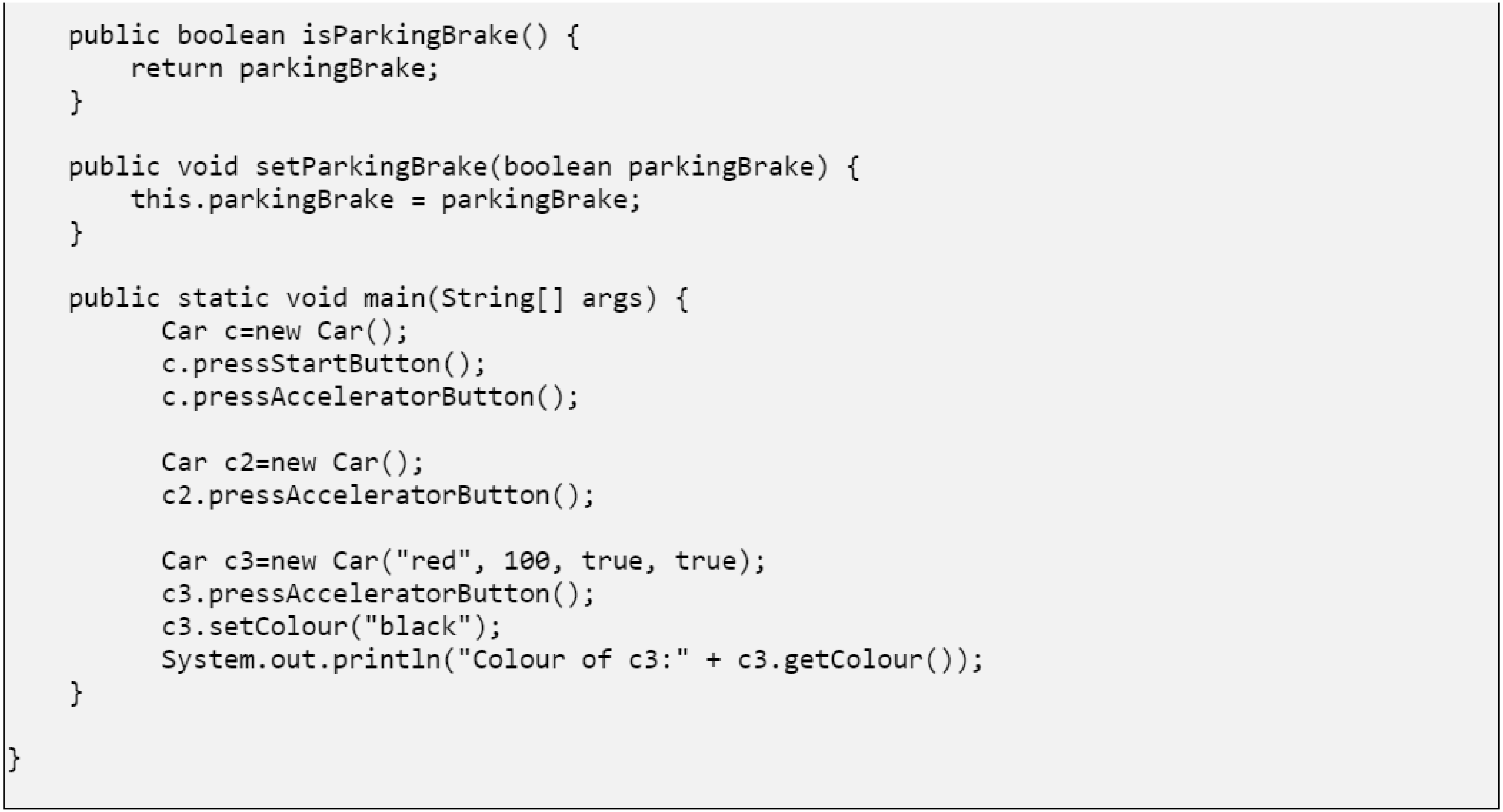
```
public class Car {
   //fields
   private String Colour;
   private int EnginePower;
   private boolean Convertible;
   private boolean parkingBrake;
   //methods
   public Car(){
       Colour="";
       EnginePower=0;
       Convertible=false;
       parkingBrake=false;
   }

   public Car(String Colour, int EnginePower, boolean Convertible, boolean parkingBrake) {
       this.Colour = Colour;
       this.EnginePower = EnginePower;
       this.Convertible = Convertible;
       this.parkingBrake = parkingBrake;
   }

   public void pressStartButton(){
       System.out.println("You can press the star button");
   }
```

# Implement



```
    public void pressAcceleratorButton(){
        System.out.println("You can press the accelerator button");
        System.out.println("Colour:"+ Colour);
        System.out.println("Engine power:"+ EnginePower);
        System.out.println("Convertible:"+ Convertible);
        System.out.println("parking brake:"+ parkingBrake);
    }

    public void setColour(String Colour) {
        this.Colour = Colour;
    }

    public String getColour() {
        return Colour;
    }

    public int getEnginePower() {
        return EnginePower;
    }

    public void setEnginePower(int EnginePower) {
        this.EnginePower = EnginePower;
    }

    public boolean isConvertible() {
        return Convertible;
    }

    public void setConvertible(boolean Convertible) {
        this.Convertible = Convertible;
    }
```

# Implement



```
    public boolean isParkingBrake() {
        return parkingBrake;
    }

    public void setParkingBrake(boolean parkingBrake) {
        this.parkingBrake = parkingBrake;
    }

    public static void main(String[] args) {
          Car c=new Car();
          c.pressStartButton();
          c.pressAcceleratorButton();

          Car c2=new Car();
          c2.pressAcceleratorButton();

          Car c3=new Car("red", 100, true, true);
          c3.pressAcceleratorButton();
          c3.setColour("black");
          System.out.println("Colour of c3:" + c3.getColour());
    }

}
```

# Summary

- The anatomy of a class, and how to declare fields, methods, and constructors.
- Hints for class design:
  - Main noun → Class
  - Descriptive nouns → Fields
  - Methods: Constructors, Getters, Setters, Normal methods
- Creating and using objects.
- To instantiate an object: Using appropiate constructior
- Use the dot operator to access the object's instance variables and methods.